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ABSTRACT

This paper presents observational and research evidence to refute two widely held beliefs about psychological development: the belief in predetermined development and the belief in the simultaneous development of all behavioral systems. Studies suggesting the plasticity of development through environmental deprivation and intervention are described. Jensen's concept of heritability is challenged with evidence from studies indicating the range of reaction available to children from a wide range of environmental backgrounds. Evidence from studies of orphanage children in Greece and Iran is included in this discussion. Observational and research evidence refuting the belief in global development is also presented. These studies highlight the inadequacy of reliance on the IQ as a measure of overall ability and indicate the value of ordinal scales for measuring achievement in specific areas of development. Evidence for retardation in certain areas of development and concurrent progress in others is said to suggest specific rather than global development. Intervention studies in an orphange in Tehran are described to provide further evidence for asynchronous development. A discussion of the educational implications of these results is included. (BD)

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Specificity in Early Development and Experience

a lecture presented by

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for

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Introduction

Dr. McVicker Hunt has made valuable research contributions in the areas of the effects of environment versus heredity on intelligence and the adaptation of Piagetian scales for assessing infant intelligence.

In his book, *Intelligence and Experience*, Dr. McVicker Hunt predicted "that with a sound scientific educational psychology of early experience it might become feasible to raise the average level of intelligence as now measured by substantial degree".

Using his own ordinal scale, derived from the work of Jean Piaget, he explored the acquisition of specific behaviors of selective populations in Greece, Iran and the United States under control and experimental conditions. He noted the positive effects of specific interventional strategies during the age which the studied behaviors were acquired. At a time when the hereditary/environment debate on IQ acquisition is being revived, Dr. Hunt assumes the position that the norm of reaction of any given genotype is a consequence of differing biographies on adaptation.

In his speech in Omaha Dr. Hunt focused his attention on two widely held Gesellian beliefs: 1) that developing organism's behavioral repertoire unfolds automatically and is predetermined at conception; and 2) that each infant develops from conception as a whole. From his own experimental observation and data by the workers (which he felicitously called "serendipity"), he argues against the Gesellian constructs of a global developmental advance equally on all fronts. There is a pertinent short discussion on the possible reasons for the lack of success of the Head Start program. He stresses the socioeducational significance of an uncritical acceptance of Head Start results particularly as they may in the future affect programs for developmentally disabled children.

His work is encouraging and practical. It's application to an interventional remedial educational curriculum for the handicapped can be a reality.

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SPECIFICITY IN EARLY DEVELOPMENT AND EXPERIENCE[1]

J. McV. Hunt[2]
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It is indeed a happy experience to be invited to give the O'Neal Lecture this year. I am highly honored. It is doubly pleasurable because the invitation comes from an institution in my own home state. I must confess, however, that in the years when I was growing up, my hometown of Scottsbluff was about as far from Omaha as China is today. Moreover, in the 1920s, when I was a student at the University in Lincoln, driving from Lincoln to Omaha was still an undertaking.

It is best that I start my discussion with a caveat. My research and my thought about it has been concerned with fostering psychological development in children without pathology. Your work concerns rehabilitative measures for children with handicaps, often multiple, in their bodily equipment. I have come with anxiety about the usefulness of what I have to offer. Fortunately, the work being done here at the Meyer Children's Center by Dr. Cordelia Robinson is a tonic. It shows how others are building on what I have to offer.

Tonight, I wish to focus the findings of some of my recent studies and studies by others on two widely held beliefs, or fictions, about psychological development. Fortunately, the empirical side of science provides correctives for erroneous fictions and theoretical constructions. To paraphrase Professor Gerald Fineberg, as reported in this week's issue of Time (2 May 1977), 'If these findings are true (and true means consistently reproduceable), they will force us to alter these two beliefs radically.'

According to the first of these fictions, the behavioral repertoire of a developing organism unfolds automatically with anatomical maturation which is determined, once and for all of a lifetime, at conception. Arnold Gesell, probably the world's most outstanding student of psychological development during the second quarter of this century, stated this belief in somewhat different fashion: "At the moment of fertilization, the original impulse of growth . . . derives its fundamental impulsions and directions from the zygote" (Gesell, 1954, pp. 353-354).

According to the second of these traditional conceptions of behavioral development, each infant develops from conception on as a whole. In Gesell's language, "the child always (develops) as an integer" (p. 339). In narrating his sound cinema entitled "Life Begins," he was even more explicit in saying, "Maturation proceeds a pace along all systems simultaneously."

Predetermined Development Versus the New Evidence of Plasticity

Conceptual antecedents of this belief in predetermined development appear in such ancient religious constructions as "things are as they are because God made them so." Consider this verse from a 19th century hymn: "The rich man in his castle,/ the poor man at his gate,/ Thank the Lord Almightly,/ He has ordered their estate." Such a view incorporated "the Divine Right of Kings." He also justified preformationism in embryology that prevailed even among scholars, despite Aristotle's observations of the epigenesis in chick development, through most of the 18th century (see Needham, 1959). As the idea of preformationism gave way to an acceptance of the idea of an epigenesis in embryological anatomy during the late 18th century, it helped pave the way for an acceptance of the idea of evolution in the 19th

century. From the evolutionary ideas of Herbert Spencer and of Charles Darwin, Francis Galton derived what seemed to him to be the necessary implication that mental development, like anatomical maturation, is predetermined by heredity. Although Alfred Binet and his collaborators, Victor Henri and Theordore Simon, invented the measurement of mental age (Binet &Simon, 1905) in the course of their search for a way to improve the learning of those children who failed in the Paris schools, Wilhelm Stern (1912) conceived the idea of dividing mental age by chronological age to obtain the intelligence quotient or IQ, and it quickly came under the control of Galton's faith. It was apparently the prevailing fiction that development is predetermined, and therefore fixed, that led to ready acceptance of the IQ as something constant throughout life. So I was taught, and in the summers of 1930 and 1931, I cooked up a way to obtain a mental age and an IQ for the infants at the Nebraska Home for Dependent Children that I examined with Gesell's schedules. Moreover, I used these IQ's as a basis for recommendations for adoptive placement. Now I suppose I am confessing one of the professional sins of my youth.

This traditional fiction of behavioral development got support from the work of George E. Coghill (1929) on the embryology of amphibians such as amblystoma, or mud puppies, and frogs, from which he concluded that the behavioral repertoire unfolds automatically with anatomical maturation. Contemporaneously, Leonard Carmichael (1926, 1927) subtracted the experience of practice in swimming by adding chloratone to the water in which eggs of amblystoma and frogs were undergoing embryological development. This appeared not to interfere with the acquisition of the swimming pattern. Moreover, adding artificial stimulation failed to hasten the appearance of the swimming pattern (Carmichael, 1928). Evidence also came from investigations at the human level that the average IQ was indeed constant for groups of human children. Of course, the average IQ was devised to be so. There were individual exceptions to the rule of constancy for the IQ, but these were explained away as errors of measurement. The size of correlations between the IQ's of pairs of individuals were found to be a function of the degree to which they were related: identical twins highest, siblings next, then cousins, etc. These gave evidence of an influence of heredity in determining intelligence. When the children of relatively uneducated working-class parents were found to have lower average IQ's than children from better educated middle-class parents, this difference between the social classes was attributed to heredity. Similarly, the existence of lower average IQ's for Black people, native Americans, and immigrants from South Europe than for White Anglo-Saxon Protestants was taken as support for the belief in the inherent, genetic inferiority of these other races and peoples then widely held (for documentation of the points in this paragraph, see Hunt, 1961, Chapters 2 & 3).

Even before World War II, evidence dissonant with this conception of predetermined development began to appear. As early as the 1920's, nursery schooling for orphanage-reared children was reported to have increased their IQ substantially. Strong issue was taken with Coghill's assertion that the behavioral repertoire unfolds automatically with anatomical maturation by Zing Yang Kuo (1932) whose heroic observations of the epigenesis of behavioral development in some 7,000 chick embryos led him to the view that the behavioral repertoire is very much a function of the activities of the embryo from the beginning. Behavior is first commuted to the organism, and an organism becomes spontaneous, or "self-winding," only gradually. The

staff of the Child Welfare Research Station at the University of Iowa, under the direction of George D. Stoddard, published a variety of studies showing that nursery school could hasten the psychological development of even home-reared children. Most spectacular, however, was a report of Skeels and Dye (1939). It was prompted by a "clinical surprise." Two residents of a state orphanage, one aged 13 months with a Kuhlmann DQ of 46 and another 16 months with a DQ of 35, were committed to an institution for the mentally deficient. At this institution, they were placed on a ward of moron women who doted on them. Some 6 months after this transfer, a psychologist visiting the wards noted with surprise that these two children had shown remarkable development. When tested again, they showed improvements in their DQs of 31 and 52 points respectively. On the basis of this surprise, a group of 13 infants from the state orphanage, with a mean DQ of 64.3 and a range between 36 and 89, were transferred to such wards at the state institution for the mentally deficient. After being on these wards for periods ranging between 6 months and 52 months, they were retested. Every one of the 13 showed a gain. The minimum was 7 points, and the maximum, 58 points. All but four showed gains of over 20 points. Conversely, 12 other infants ranging in age from 12 to 22 months with a mean DQ of 87, ranging from 50 to 103, were left in the orphanage. When these were retested after periods ranging from 21 to 43 months, all but one showed a decrease in IQ ranging between 18 and 45 points.

This evidence from before World War II failed to weaken belief in the fiction of predetermined development. Kuo's work scarcely got known among those concerned with the welfare of human children. Those studies employing children as subjects met with statistical criticisms that had a certain validity. As a consequence, the findings of these studies lost what suggestive value they should have had (for documentation, see Hunt, 1961, Chapters 7 & 8).

Following World War II, studies inspired by the neuropsychological theorizing of Donald Hebb (1949) and the neurochemical theorizing of Helgar Hyden (see Brattgard, 1952) uncovered effects of early sensory and sensorimotor experiences in both behavioral adaptability and microscopic neuroanatomy in rats, cats, dogs, and monkeys (for reviews, see Hunt, 1961, Chapter 4; 1969, pp. 11-13,; 1976). Findings of such studies were immune to the statistical criticisms of those earlier studies that had uncovered effects of nursery schooling in human subjects. In the 1950s, when the work of Jean Piaget (1936, 1937, 1945, 1947) on the development of intelligence got translated, it began almost immediately to have an influence. His idea that the child constructs conceptions of reality in the course of coping adaptively with his environments, physical and social, provided a new way to interpret the differing effects of environmental circumstances even though his major concern was epistemological rather than educational. His theorizing helped to explain how the effects of differing environments come about through the adaptive changes taking place in developing organisms as they accommodate their abilities and understandings to normal and ever more demanding circumstances (see Hunt, 1961, Chapters 6 & 7).

It should be noted here that tests can only measure the abilities and understandings achieved through experience past. Never can they predict the achievements of the future without specifying the conditions of development in that future. Although we can conceive of individual differences in hereditary potential, what we observe and measure are only achievements (Humphreys, 1962; Hunt, 1961, pp. 301-305).

After assembling and reviewing such evidence in 1961, I concluded: "It is highly unlikely that any society has developed a system of child-rearing and education that maximizes the potential of the individuals which compose it. Probably no one has ever lived whose full potential for happy intellectual interest and growth has been achieved. Various bits of the evidence reviewed hint that if the manner in which encounters with the environment foster the development of intellectual interest and capacity were more fully understood, it might be possible to increase the average level of intelligence within the population substantially . . . there would be, of course, a long step between learning how to affect changes in child-rearing and getting them adopted by the culture, but learning how is the first step" (Hunt, 1961, p. 346). And, again: "In the light of the evidence now available, it is not unreasonable to entertain the hypothesis that, with a sound scientific educational psychology of early experience, it might become feasible to raise the average level of intelligence as now measured by a substantial degree. In order to be explicit, it is conceivable that this "substantial degree" might be of the order of 30 points of IQ. In a technological culture which is requiring more and more people with a high level of intelligence, this is an important challenge. At this stage of investigation, however, it is still a challenge for investigation rather than one for application and social change" (Hunt, 1961, p. 267).

Shortly after the paragraphs above appeared, Benjamin Bloom (1964) published a synthesis of longitudinal studies undertaken during the previous 50 years in various parts of the world. While the findings for the several characteristics measured differed to some extent, those concerned with such characteristics as verbal ability, general intelligence, and school achievement, showed a pattern of very rapid development in the early years followed by slower and slower development thereafter. For intelligence, Bloom drew the conclusion that by the age of four, half of the variance among children in intelligence, or IQ, has already been accounted for. From the evidence he had assembled, Bloom concluded that "we cannot imagine any research worker or any research in disagreement with the basic proposition that the environment is a determiner of the extent and kind of change taking place in a particular characteristic . . . the evidence is clear that the increments for a particular characteristic are in part determined by the environment" (Bloom, 1964, p. 209). Although I would differ with Bloom's phrase "determined by the environment," for I would attribute nothing directly to the environment, I agree heartily with the intent of his statement.

Project Head Start

Sometimes a new conception of reality helps to instigate social change. According to Steiner's (1976) book on *The Children's Cause*, after penetrating the politician's veil of selective attention through the concern of the Kennedy's for mental deficiency and the interest and knowledge of their pediatric adviser, Dr. Robert Cooke, it was these evidences of plasticity in early psychological development that encouraged Presidents John Kennedy and L. B. Johnson to launch Head Start as a major component of their War on Poverty. It is one thing to consider something possible or achieveable, and quite another thing, however, to know how to do it. Project Head Start was launched without "a sound, scientific, educational psychology for infancy and early childhood." The curricula deployed for a summer or perhaps a whole year of compensatory education was typically that developed during the 1920s and 1930s to give the children of over-controlling middle-class mothers a period of free play in order to avoid the strict consciences to which many of the early psychoanalysts attributed neurotic characters.

When evidence from the Westinghouse Study (Cicarelli, *et al.*, 1969) indicated that the effects of such nursery-schooling were highly limited and transitory, Arthur Jensen (1969) published a widely-read article in the *Harvard Educational Review* claiming that Project Head Start had failed because, as he quoted E. L. Thorndike, "In the actual race of life, which is not to get ahead, but to get ahead of somebody, the chief determining factor is heredity." Jensen went on to revisit the contention, which had become traditional in the textbooks of psychology before World War II, that at least 80% of the individual variations in the IQ are attributable to heredity. The Westinghouse Study and Jensen's revisiting this traditional fiction of predetermined development damped the enthusiasm of many of the people in the federal government, and especially of President Nixon and his staff, for programs of early education. It is a matter of importance in such a discussion as this, therefore, to call attention to the new evidences of plasticity that have appeared since those books by Hunt (1961) and Bloom (1964) were published in the early 1960s. This importance is no mere matter of academic, scientific validity, it is even more important in terms of the rights of children – their right to an equal opportunity to achieve the abilities and understandings demanded for productive participation in the mainstream of our highly technological culture. This is a culture which emphasizes the importance of adaptability, initiative, and especially of intellectual grasp of relationships along with the semantic mastery of these relationships in the symbols of language and numbers, spoken and written.

Heritability Versus the Range of Reaction

According to the traditional argument that Arthur Jensen (1969, 1972, 1973) has revisited, the estimate of how much intelligence and academic achievement are to be modified by the environment is to be obtained indirectly from subtracting estimates of heritability from the total variance, or 100%. Estimates of heritability, expressed as a percentage of the total variance attributable to heredity, derive from statistical manipulations of the differing degrees of correlation between the IQ's of pairs of individuals with differing degrees of hereditary relationship, or proportions of genes in common (see *e.g.*, Jensen, 1967; McGuire & Hirsch, 1977). The procedure of subtracting such estimates of heritability from the total variance to estimate the percentage attributable to the environment, or rather to biographies of adaptation, is therefore always indirect. Moreover, indirect estimates of the effects of biographical experience derive from a theoretical model of the influences of heredity and environment originally formulated by R. A. Fisher (1918). Both the incompleteness of the Fisher model and its usual interpretation have now been discussed and explicated by Hirsch and Vetta (1977). They point out that when unusual values of phenotypic-correlation differences occur, far from being evidence of no environmental effects, as Fisher believed, they provide evidence of environmental effects. Using such indirect estimates of the effects of differing biographies of adaptation to estimate the educability of individuals is highly dubious, whether or not Fisher's theoretical model adequately achieved a bridge between Mendelian genetics and the analysis of variance model for separating the effects of heredity and environment. It is dubious because any estimate of heritability, and therefore any estimate of environmental influence, holds only for the particular sampling of genotypes and environments on which the correlations between related individuals are based. Much more clearly and directly relevant to educability is evidence deriving from a methodology suggested by

the concept of the "norm of reaction" formulated in 1909 by Richard Woltereck (see Rieger, *et al.*, 1968, p. 372). This norm is the range of variations in measures of any phenotypic trait to which a given genotype can give rise as a consequence of differing biographies of adaptation. Thus, ever since 1909, the discipline of genetics has explicitly recognized a developmental influence from the adaptive activities elicited by differing environmental circumstances. A strategy for assessing directly the range of reaction for any phenotypic characteristic consists in ascertaining the difference between the means of measures of that characteristic for samples of individuals derived from a given population who have developed under contrasting conditions of rearing.

Unfortunately, data from such a strategy of investigation with either animal or human subjects are exceedingly few. On the fortunate side, however, those few available are of highly suggestive significance.

Some of these available data come from recent investigations conducted by my collaborators and myself. One of these concerns the difference between the mean ages at which samples of infants being reared under differing conditions achieve top-level object permanence (see Hunt, Paraskevopoulos, Schickedanz & Uzgiris, 1975). The scale of Visual Following and Object Permanence is one of those for the assessment of sensorimotor development inspired by Piaget's (1936, 1937) observations of the development of intelligence and of the constructions of reality in his own three children. This scale is ordinal in character in the sense that each step builds upon the achievements represented in earlier steps (Uzgiris & Hunt, 1975). Such scales permit a major change in the strategy of assessment (see Hunt, 1976). They permit one to identify levels of development by means of behavioral landmarks. One can then compare the distribution of ages at which groups of children being reared under differing conditions achieve the various behavioral landmarks.

The scale of Object Permanence, as the name implies, concerns a series of landmarks in the progressive construction of the object concept. During the first several months of an infant's life, objects have little or no permanence or persistence; once they are out of sight, they are also out of mind. An infant may show interest in an object, but once it is even only partially covered, his interest disappears. Or, he may show interest in a partially covered object, but not one completely covered. He may retrieve an object hidden by only one cover, but find three superimposed covers too much. Later, he may remove an indefinite number of superimposed covers, but once a desired object has disappeared into a container, and that container has in turn disappeared, only to come back empty, the child loses interest. For top-level object permanence, the child's interest in the desired object persists through the disappearance of the object into a container and through a series of three disappearances of that container, with the child retrieving the object by going to the place where the container disappeared last and proceeding to search in reverse order through the places where the container has disappeared. Such behavior implies that the child can play his representative central processes, imagery if you will, backward as well as forward.

For the most retarded group of children that we have found, those reared at the Municipal Orphanage of Athens, Greece, where the infant-caretaker ratio is of the order of 10/1, the mean age of achieving this top landmark on the scale of Object Permanence is 182 weeks or 3.5 years. The

most advanced group consists of 8 consecutive infants born to the parents served by the Parent and Child Center of Mt. Carmel, Illinois. The parents served by this Center are the poorest and least educated within the community. These 8 infants, however, had the advantage of half-days of educational day-care where some of the mothers served as caretakers after being taught the learning programs for infants and for toddlers devised by Earladeen Badger (1971a, 1971b). These 8 infants achieved top-level object permanence at a mean age of only 73 weeks, or 1.4 years. The difference of 109 weeks is over two years (see Hunt, *et al.*, 1975).

Unfortunately, we have no ready-made standards for interpreting this difference of 109 weeks in mean age of achieving the top step on this scale of Object Permanence. It may, therefore, be useful for purposes of communication to transform this difference into the terms of the more familiar IQ-ratio. For this purpose, we can use the mean age at which home-reared children, one group in Athens and the other in Worcester, Mass., have achieved this top step on the scale of Object Permanence. Their mean age of 110 weeks can serve for the purposes of this transformation as the mental age for this particular branch of development. If one divides this 110 weeks of mental age for the top-level of object permanence by the mean age of 73 weeks at which it was achieved by the infants at Mt. Carmel, the resulting IQ ratio is 1.5. Once that is multiplied by the 100 in the formula, it becomes an IQ-ratio of 150. Now if one divides the mental age of 110 weeks by the mean age of 182 weeks at which this step was achieved by the children developing in the Municipal Orphanage of Athens, the resulting IQ-ratio is .6, or 60. Subtracting the latter from the former yields a difference of 90 points in the mean IQ-ratio for this one branch of development. Note, however, two limitations. First, an IQ-ratio for one branch of development is not a DQ or an IQ because these are based on developmental or mental ages, and through the process of substitutive averaging involved, they represent all branches of development. Second, note that the children from Mt. Carmel and the children at the Municipal Orphanage in Athens do not fit the definition of a population genotype where individuals from the two sexes have equal opportunities for mating. On the other hand, why should anyone claim that children born to the poorest and least successful parents in a middle-western American town have less genotypic potential for object construction than the children of working-class people of Athens, Greece? This difference of 90 points of IQ-ratio, which appears to be attributable to both the retarding effects of experience in the orphanage and the development-fostering value of the day-care provided at the Parent and Child Center in Mt. Carmel, is far greater than anything I would have thought conceivable in 1960 when I was writing *Intelligence and Experience* (Hunt, 1961).

Although this difference of 109 weeks between the mean ages of groups of children being reared under differing conditions is the largest we have found for achieving the top steps on any of our sensorimotor scales, those obtained for samples of infants being reared at the Orphanage of the Queen Farah Pahlavi Charity Society in Tehran with interventions designed to foster development are very substantial. Of the differences obtained with the seven scales, the smallest is 48 weeks, and, curiously, this is for obtaining the top step on the scale of Object Permanence. The other differences range from 52 weeks to 80 weeks. When these differences in mean ages of achieving top steps on the scales are transformed into differences in mean IQ-ratios for each branch of development, they range between a minimum of 32 points of IQ-ratio for Object Permanence to a maximum of 78 points for

Gestural Imitation. In the case of these differences obtained at the Orphanage in Tehran, the samples of infants all consist of foundlings who got to the Municipal Orphanage of Tehran and who were then transferred before they were a month old to the orphanage of the Queen Farah Pahlavi Charity Society as subjects in our experiments. Lest you be shocked by the idea of using human infants as subjects in child-rearing experiments, you should know that routine practices of care at the Orphanage of the Queen Farah Pahlavi Charity Society have always been very much better than that at the Municipal Orphanage. You should know also that each successive intervention in the child-rearing at the Orphanage of the Queen Farah Pahlavi Charity Society was designed with the idea of improving the development-fostering quality of the care. My main concerns at this juncture, however, are two. I wish first to indicate that the difference in mean ages for obtaining the top step on the scale of Object Permanence holds also for other scales. Second, I also wish to note that very substantial differences were obtained when the samples of infants came from what is about as close as approximation to a population genotype as one is likely to find with human subjects.

Even so, these findings concern only sensorimotor achievements which are typically obtained in home-reared children of middle-class at somewhere between 18 months and 2 years of age. Is there any evidence that such differences might extend to later ages? The answer is yes, for slightly more than a decade ago, Wayne Dennis (1966) assembled the findings available from giving Florence Goodenough's (1926) Draw-A-Man Test to samples of typical children aged 6 to 9 years from 50 cultures over the world. You will recall the Florence Goodenough originally designed her test to be "culture free." But culture free it is not; nor is any test, because all tests measure achievements with experience. The top mean IQ on this test was 125, and it was scored by a sample of 6-year-old American children from middle-class families. Scores nearly as high came from samples of Japanese children, and Japanese children of poverty from coastal fishing villages along with Hopi and Navajo Indian children obtained mean IQs within 10 points of this top. At the bottom end of the scale were mean IQs of 53 for samples of Shilluk children of the Sudan and 56 for Bedouin children of Syria. This range from a top mean IQ of 125 to a bottom mean of 53 is 72 points. To be sure, the factor-analytic structure of performance on the Draw-A-Man Test is probably considerably less complex than that of performances on such standard measures of intelligence as the Stanford-Binet scale or the Wechsler Children's Scale. Moreover, since this is a cross-cultural study, the samples of children are definitely not from one population genotype. The kind of experience that appears to be important here is meaningful interaction with representative graphic art. Such experiences are prevalent for children in middle-class American families, for Japanese children, and for children of Hopi and Navajo Indians who participate in the representative art of their sand paintings.

By combining findings from different studies, one can also obtain direct evidence from the "range of reaction-strategy" based on standard measures of intelligence. Evidence that traditional orphanage rearing reduces the mean IQ of children of school age by 50 points comes both from the study of Skeels and Dye (1939) and from the more recent study by Wayne Dennis (1973) based on Children of the Creche in Lebanon. To this decrease in mean IQ of 50 points one may add an increase in mean IQ which has been obtained through intervention. Heber, Garber, *et al.* (1972) have utilized

educational day-care in which there was a caretaker for each infant to foster psychological development in the offspring of uneducated mothers from the poverty sector who had IQ's of 75 or below. The treatment began when the infants were six months old and it was continued until they attained school age. When the infants in this treated group were 66 months old, their mean IQ was 124. If one adds the 24 points that this mean is above the average of 100 for the population to the 50 points of retardation due to orphanage-rearing, one gets a "range of reaction" between mean IQ's based on the standard tests of intelligence of 74 points of IQ. Inasmuch as another sample of 20 infants from a similar set of mothers attained a mean IQ of only 94 without the educational day-care, adding only the 24 points of advance above the norm for the treated group to the 50 points of retardation for the orphanage samples appears to be a conservative statement about the range of mean IQs resulting from rearing under radically different conditions.

Obviously more and better data from this strategy of investigation suggested by the concept of the range of reaction are needed. But these data, few as they are, are far more relevant to the issue of educability than are any of those derived indirectly from substracting percentage estimates of heritability from 100 per cent of total variance. As of now, I believe all children born without evident pathology have the genotypic potential necessary to achieve all of the abilities and knowledge required for productive participation in the mainstream of any culture on this earth. Of the children now placed in classes for special education, it is common to estimate that 80% are there because they are "educationally disadvantaged." This may be an underestimate. These statements do not deny individual differences in genotypic potential, but we cannot measure genotypic potential. Certainly, with such evidence of plasticity, there is no need to revisit the belief in predetermined development because Project Head Start failed to achieve the unrealistic goals that people set for it. The "failure" of Head Start can properly be attributed partly to the technologies available at the time, and partly to failure to involve parents in the education of the young from birth on.

THE BELIEF IN GLOBAL DEVELOPMENT VERSUS THE EVIDENCE OF SPECIFICITY

The belief that each infant and child develops from the moment of conception as a whole is another fiction that has gone unanalyzed. The fiction grows naturally out of the concept of maturation as a process completely predetermined by the genotype. So long as development is conceived to be an automatic unfolding of behavior with anatomical maturation, it is natural to conceive of it as a global process. Psychoanalytic theory offered no correction. Although Freud (1905) explicitly made a significant role for early experience in emotional or personality development in his "Three Contributions to the Theory of Sex," the successive oral, anal, and genital stages were globally conceived. The observers of the embryology of behavioral development have commonly found Gestalt psychology compatible with their observations. Thus, George Coghill (1929) described the successive patterns of action in larval amblystoma in Gestalt terms. Even Piaget has described his stages in Gestalt terms. Thus, for instance, he describes his fifth sensorimotor stage as marked by "a search for novelty as such." This search for novelty brings innovations in behavior which include "the discovery of new means to active experimentation," actions becoming differentiated as ends of goal as well as means of achieving goals, a shift in

the infant's attention from his own action to external objects which brings about a differentiation among those objects and a discovery of their social uses. All this constitutes a sensorimotor organizational structure for which Piaget used the French term "ensemble" or Gestalt.

Such a view, however, is not the only one. At the other extreme are the behaviorists who have emphasized an almost unlimited influence of learning in the process of development. For behaviorists, the unit of behavior has been the reflex arc. One form of learning has been conceived, in the terms of Pavlovian conditioning, as a matter of connecting motor actions with new stimuli, and another form as chaining stimulus-response units into systems. One of the major concerns of students of the embryology of behavior has been a search for data that will provide a basis for choice between these two concepts of original nature (see Carmichael, 1954, Chap. 2). As is often true with such dichotomous conceptual constructions, neither represents reality very well (see Hunt, 1969).

There is also an empirical basis for the lack of a proper analysis of this fiction of global development. For nearly three-quarters of a century, the chief tools for assessing development have been those based on "developmental age" or "mental age," and the derivitive DQ or IQ used above in presenting the new evidence on plasticity. In their search for a metric with which to quantify intelligence, or what they call the "fundamental faculty," Binet and Simon (1905) gave each test item in a battery a value of two months of mental age. Thus, each item could substitute for any other item in that battery for determining the "developmental age" or "mental age" of an individual. This was brilliant as a method of simplifying the complexities of measurement. On the other hand, it has served like a blanket to obscure the details in the organizational structures and the experiential sources of the achievements represented in these test items. When Wilhelm Stern (1912) hit upon the IQ-ratio, with the suggestion of dividing the mental age of an individual by his chronological age, he devised still another metrical blanket which obscures the details of the structural relations among developing abilities. As we have already seen, the idea of predeterminism made this IQ-ratio a constant and fixed dimension of a person.

Even though the substitutive averaging of items to obtain the mental age and the dividing of the mental age by the chronological age to obtain the IQ tended to obscure the details of psychological development, they could not hide completely the evidence dissonant with the presumption of global development. During the decades of the 20s and the 30s, at least a score of papers concerned with "scatter" on the Stanford-Binet test were published (see Harris & Shakow, 1937, 1938). These were based on the test performances of children and of psychiatric patients whose failures and successes were found to occur over several years of mental age. These studies were highly familiar to me (Hunt, 1936; Hunt & Cofer, 1944), and they led me to suspect considerable variation in the rates of development along separate branches. Moreover, in his book on "The Origins of Intelligence in Children," Piaget (1936) himself noted marked differences in the ages at which his three children first began to watch their hands. The oldest, Jacqueline, did not manifest this sensorimotor organization until she was 6 months old. The youngest, Laurent, on the other hand, manifested it when he was only 3 months and 6 days old. Piaget explained the difference in terms of experience or "the whole history of ocular-manual coordinations." Jacqueline was born in January. She spent most of her waking hours outdoors on a balcony. Consequently, to keep her warm, her hands were

kept constantly under covers and out of sight during most of the first five months of her life. Laurent, born in May, needed no such covers, so his hands were available for visual scrutiny from shortly after birth. Familiarity with the evidence of scatter on the Stanford-Binet test and with this homely item in the writings of Piaget prepared me to be watchful for variations in the rates of development along the different branches assessed by our Piaget-inspired scales with differing kinds of experience.

Ordinal Scales of Sensorimotor Development

Piaget's (1936, 1937) observations of the development of his own three children confirmed and elucidated impressions that I had from observing my children. Development appeared to come not alone from maturation but from the infant's experience of interacting adaptively with his environmental circumstances. Behavioral development appeared, moreover, to go through an epigenetic sequence of changes. This is not to deny an influence from heredity; obviously one does not obtain kittens by breeding rats. Moreover, there are individual differences among human genotypes. Nevertheless, it appeared likely that the infant's adaptive efforts at coping with his diverse environmental circumstances would contribute significantly to sequence and rate of development. Sequentiality in behavioral development need not be entirely a matter of heredity as has often been claimed (see *e.g.*, M. M.Shirley, 1933). Moreover, the sequentiality evident in Piaget's observations suggested the possibility of ordinal scales. In our set, each scale represents what appears intuitively to be a separate branch of sensorimotor development (see Uzgiris & Hunt, 1975). In constructing these scales, we did not accept Piaget's formulation of six sensorimotor stages. Each scale has as many steps as we found landmarks on which observers could readily agree. The first of the scales concerns Visual Following and Object Permanence. It reflects the process of object construction, already discussed above, and it has 14 steps. The second scale concerns the development of means for obtaining desired environmental events and it has 13 steps. The third scale concerns the development of Imitation, but there are two parts, one concerned with Vocal Imitation and another with Gestural Imitation. Each part has 9 steps. The fourth scale concerns the Development of Operational Causality, and it has 7 steps. The fifth concerns the Development of Object Relations in Space, and has 11 steps. The sixth concerns the Development of Schemes for Relating to Objects, and it has 10 steps.

These ordinal scales permit modifications of the traditional strategy for assessment of development. The fact that the scales are ordinal in character permits one to identify the level that an infant has achieved along a given branch of development. One can describe the development of an individual in terms of the levels he has achieved on each of these scales. One can also compare the age distributions of groups of children at a given level on one of the scales who have developed under differing circumstances or rearing conditions. Moreover, in longitudinal studies where measures are repeated at regular intervals, one can readily compare the ages at which infants developing under differing circumstances attain specified landmarks of development along the several branches. It is having scales for the several branches that has permitted us to uncover an unsuspected degree of specificity in relationships between various kinds of experience and various kinds of development.

Serendipitous Observations

Although we expected to find some specificity in relationships between kinds of experience and kinds of development, uncovering all but one has

been a matter of serendipity. In 1965, I made a visit to the laboratory of Burton L. White, now the author of a new book entitled *The First Three Years* (White, 1975). I had made the trip with the naive idea of learning how to measure visual accommodation with dynamic retinoscopy and to explore the feasibility of using it as a measure that would reflect the effects of having a mobile over the crib to look at. White had done a normative study of eye-hand coordination in which fisted-swiping appeared at a median age of 65 days and top-level, visually-directed reaching had appeared at a median age of 145 days. White had already studied the effect of a massive enrichment program that included turning the infant up on his stomach for a few minutes after each feeding, periods of handling each day, and fixing a complex stabile over the crib, beginning at 90 days of age. This massive enrichment actually served to delay fist-swiping by a week, but it hastened the achievement of top-level reaching so that it appeared at a median age of 106 days. White thought the delay in fisted-swiping might result from the fact that the stabile was too complex. The fact that it subtended nearly 90 degrees of visual angle made it difficult for infants to escape it. When he simplified the visual display for the first 50 days and then introduced the massive enrichment, he reduced the median age of both landmarks in eye-hand coordination. In fact, his third sample of infants achieved top-level reaching at a median age of 89 days. This is an advance of 56 days, and it constitutes a change in IQ-ratio of 63 points for eye-hand coordination. This was remarkable to me, because the home-reared children who were serving as subjects in our efforts to develop ordinal scales were achieving top-level reaching at about 150 days. When I mentioned that our home-reared infants would typically manifest vocal pseudo-imitation at 75 or 80 days of age, he became interested in whether the children in his sample would manifest this behavioral phenomenon. It consists in showing interest and responding vocally when an adult makes sounds with which the infant is familiar because he has already been observed to make them. Vocal pseudo-imitation, however, could be elicited from none of those in White's institutional group, not even in those as old as 180 days. This appeared to be a case where the enrichment programs provided by Dr. White had served to hasten visually-directed reaching in his institutional children sufficiently to bring their median age of attaining top-level reaching about 60 days ahead of the mean age at which it was attained in our home-reared infants. On the other hand, the experience of vocal play that is exceedingly common in middle-class families had served to bring about the appearance of vocal pseudo-imitation at a mean age earlier by at least 100 days than it could have been achieved by the institutional infants who had essentially no experience of vocal play. Clearly progress had not proceeded a pace, to paraphrase Gesell's statement, along these two systems of eye-hand coordination and vocal pseudo-imitation in White's institutional infants and in our home-reared infants.

A second serendipitous observation came in connection with our study of the effects of educational day-care on the eight consecutive infants born to the parents served by the Parent and Child Center of Mt. Carmel, Illinois. The intervention that served to advance the mean age of achieving the top steps on our scale of Object Permanence to 73 weeks by these 8 infants of Mt. Carmel, 25 weeks ahead of the mean age of 98 weeks for the home-reared offspring of predominantly professional families in Worcester, Mass., left these 8 infants of Mt. Carmel 20 weeks, or approximately 5 months, behind the Worcester infants in achieving the top step on the scale of Vocal Imitation. If, for the purpose of communication, one transforms

the difference between the mean ages for these two achievements into the terms of the IQ-ratio, they are 52 points apart. Achieving the top step on the scale of Object Permanence at an average age of 73 weeks puts the infants of Mt. Carmel, who got the educational day-care, 34 IQ-ratio points ahead of the infants of Worcester, but their 20 weeks of retardation in achieving the top-step on the scale of vocal imitation puts them 18 points of IQ-ratio behind the Worcester children. Such a marked discrepancy in the level of development for the branches of object construction and vocal imitation calls to mind again the findings from the studies of scatter on the Stanford-Binet. In the 1920's and 30's, when the studies of scatter on the Stanford-Binet were conducted, the existence of scatter was typically interpreted to be a consequence of chronic pathology in the individual due to heredity or disease. The fact that this discrepancy exists between the means of measurements for groups of children reared under differing conditions demonstrates that the differences in the experiences of the two groups can be the cause of discrepancies in advancement along different branches of development. Also, this fact suggests that such discrepancies can be modified by appropriate experience, but the difficulty of achieving modification increases with the duration of the discrepancy's existance.

A third serendipitous observation of such specificity occurred in our Athens study (Paraskevopoulos & Hunt, 1971). There we examined every child between the ages of five months and five years at the Municipal Orphanage of Athens, where the infant caretaker ratio is of the order of 10/1, and at Metera Center, where the infant caretaker ratio is of the order of 3/1. We examined these infants with the Piaget-inspired scales of Object Permanence and Imitation, both Vocal and Gestural. We also examined 57 home-reared children of working-class mothers. The mean ages of the children from these three sources who were at the top steps on these scales differed substantially. For those at the top level of object permanence, those reared at the Municipal Orphanage averaged 45.4 months of age; those reared at Metera Center averaged 35.7 months of age, and those home-reared averaged 30.2 months of age. For those at the top level of Vocal Imitation, those reared in the Municipal Orphanage averaged 40.8 months, those at Metera Center 37.0 months, and those home-reared 28.3 months. For those at the top-level of gestural imitation, those reared at the Municipal Orphanage averaged 30.4 months, those at Metera Center averaged 26.2 months, and those home-reared 24.9.

Now if development "proceeds a pace along all systems simultaneously," one would expect a given set of differing kinds of child-rearing to have the same effects on the age achieving the top landmarks on all of these scales. Such an expectation is grossly wrong. For instance, a difference of 15.2 months separates the mean ages of the Municipal Orphanage children from those home-reared at top-level Object Permanence, but a difference of only 5.5 months separates the mean ages of these two groups of children at top-level Gestural Imitation. In other words, however the rearing experiences for children at the Municipal Orphanage differ from the rearing experience of those home-reared makes nearly three times as much difference in the mean age of achieving top-level Object Permanence as it does of achieving top-level Gestural Imitation. Consider another example. A difference of 9.7 months separates the mean ages of the children reared in the Municipal Orphanage and those reared in Metera Center in age of achieving top-level Object Permanence, but only 3.8 months in achieving top level Vocal Imitation. Here again, whatever the difference is in the rearing experience of

these two orphanages, it had more than 2½ times as much effect on the age of achieving top-level Object Permanence as it had on the age of achieving top-level Vocal Imitation.

In constructing our Piaget-inspired scales (Uzgiris & Hunt, 1975, see below), we had presumed imitation to be a single process which appears in two domains, the vocal and the auditory. It is clear, however, that orphanage-rearing retards the mean age of achieving top-level Vocal Imitation, where the infant must readily imitate a variety of unfamiliar vocal patterns, more than it retards top-level Gestural Imitation, where the child must imitate unfamiliar patterns with his facial muscles that are out of his own field of vision. More than a year separates the mean ages of those reared at the Municipal Orphanage from those reared in their own homes at top-level Vocal Imitation but less than six months separates the mean ages of these groups of children at top-level Gestural Imitation. This becomes readily understandable when one considers two relatively obvious facts. First, these two examples of imitation depend upon different receptor modalities. Vocal imitation depends chiefly upon auditory reception, while gestural imitation depends upon visual perception. Second, children in orphanages seldom hear speech unless they are pets of some caretaker. Caretakers seldom talk to the infants in their charge. On the other hand, the infants in orphanages can readily see what caretakers are doing, and gestural responses to infant actions are probably more common than vocal responses of caretakers to infant vocalizations. The fact that mothers more commonly talk to their infants than do caretakers accounts for a relatively greater advancement in Vocal Imitation of the home-reared infants than in either Gestural Imitation or in Object Construction. It is interesting in this connection that Metera Center has been held out as an ideal institution for infants. The institution has a school for infant nurses, but these students serve under supervision in the care of no more than three infants. Apparently, however, the curriculum at the school does not include teaching the student caretakers how to foster vocal imitation which I believe is the major sensorimotor precursor of language.

EVIDENCE FROM INTERVENTION IN THE CHILD-REARING AT THE ORPHANAGE IN TEHRAN

For a decade I have been directing a program of research on the experiences which foster psychological development in infancy at the Orphanage of the Queen Farah Pahlavi Charity Society in Tehran. Several factors account for the choice of this Tehran orphanage. First, following World War II, the work and the motion pictures of Rene Spitz (1945, 1946a, 1946b) convinced psychiatrists, clinical psychologists, and social workers that orphanage-rearing was pathogenic for infants and young children. Their lobbying in the legislatures led to laws mandating foster care in place of institutional care for infants, and also put strict limits on the number of infants for which one caretaker could accept responsibility. Second, by the late 1950's, when I began wanting an institutional laboratory in which to test my theorizing about the role of intrinsic motivation (*i.e.*, motivation inherent in information processing and action, in psychological development, I received from Wayne Dennis (1960), a colleague and friend of long standing, a description of the apathy and retardation he had observed in the infants and young children of an orphanage in Tehran. Third, it appeared to me that this orphanage might be a place where, if my theories were at all correct, I might be able to intervene in the child-rearing practices to provide evidence

of dramatic effects of differing biographies of adaptive efforts. Unfortunately, it took about 7 years to find both a suitable collaborator and the necessary financial support for the program. This was finally achieved in 1966, when I managed to obtain financial support from the National Institute of Mental Health, found an Iranian collaborator, and got permission from the Office of the Queen Farah Pahlavi Charity Society to conduct the study in the orphanage in Tehran supported by the Society. By this time the Queen's Society had already made a substantial series of reforms in the child-rearing practices of the orphanage. By late 1968, my collaborator had established the laboratory in the orphanage and we began the program (see Hunt, Mohandessi, Ghodssi, and Akiyama, 1976).

For both ethical and scientific reasons, we made no attempt to have contemporary treatment and control groups. Instead we have employed what I like to call "wave design." Our subjects have been foundlings whom Mehri Ghodssi, our collaborator who directed the orphanage, selected from among those newborn infants without parents at the Municipal Orphanage. The first sample, or wave, consisted of 15 of these foundlings judged by Miss Ghodssi and her attending pediatrician to be without pathology. These infants and those in subsequent waves were less than a month old when they were transferred from the Municipal Orphanage to that of the Queen Farah Pahlavi Charity Society. These first 15 were reared according to the child-rearing practices standard for the orphanage. The infant-caretaker ratio was typically of the order of 10/1. The only intervention for this control wave consisted of the repeated examining with our Piaget-inspired ordinal scales (Uzgiris & Hunt, 1975) every other week during their first year and every fourth week thereafter.

Work with Wave II of 10 such foundlings began about a year and a half after work with the controls had started. Again, the Piaget-inspired scales were administered every other week during the first year, and every fourth week thereafter. For this group, however, there was an intervention designed to foster their psychological development. This intervention was what we have called "audio-visual enrichment." On each side of every crib a speaker was attached just opposite the infant's ears. Each speaker was connected with one of two tape recorders. Each tape recorder was provided with a loop of tape on which was recorded a combination of music and mother-talk. One loop was relatively short so that the music and the mother-talk was repeated often. The loop for the other was longer, so the "message" was repeated less often. At first, both speakers were hooked to the more redundant message. Each infant was provided with a plastic wrist-band and a string attached to a switch that enabled him/her to turn the speaker on by making a simple arm motion. After 15 seconds, the music and mother talk was automatically shut off, and the infant had to pull the switch a second time to obtain it. This made the music and mother talk available to the infants at their will. As the infants developed, they were to have been given a choice of the more or less redundant tapes by having two switches, one connected to each of the speakers. The intended visual enrichment for these infants in Wave 2 consisted of mobiles hung over their cribs. Each mobile consisted of a disc five inches in diameter with three dangles of color wool-yarn. Each mobile was attached to a spring that in turn was attached to the crib mattress so that the infant could shake himself and activate the dangles. By the time work began with this second wave, I had a new collaborator in Tehran. When she failed to keep the apparatus running, the intended audio-visual enrichment became abortive.

Work with Wave III began early in 1972 with a third collaborator as resident director. Wave III consisted of another 10 foundling infants without pathology who were brought to the orphanage of the Queen Farah Pahlavi Charity Society when they were less than a month old. The repeated testing was carried on for this group and the intervention, which we have referred to as untutored human enrichment, consisted merely in reducing the infant-caretaker ratio from 10/1 to 10/3 in order to allow the caretakers more time for interaction with their infant charges. No tutelage in caretaking was provided. They did what came naturally. Each caretaker, it should be noted, was equally responsible for all ten infants.

Wave IV consisted of 20 infant foundlings without pathology. They got the usual repeated testing with the Piaget-inspired scales. The intervention consisted of the audio-visual experiences originally planned for Wave II, but this time they were administered essentially as planned.

Wave V consisted of 11 infant foundlings who got tutored human enrichment. They too were repeatedly examined every other week during their first year and every fourth week thereafter. The infant-caretaker ratio was reduced from 10/1 to 3/1 or in most cases 2/1. This means that each caretaker was responsible continually for the same two or three infants. The tutelage of the caretakers included training in the use of the Badger programs of infant (1971a) and toddler (1971b) learning that had been employed with the mothers who served as caretakers for the educational day-care at Mt. Carmel, Illinois. Because this learning program had failed to foster vocal imitation, however, it was supplemented. The supplement had two parts. One, to foster vocal imitation, consisted of caretakers imitating their infants' early cooing sounds to get vocal games going. These vocal games were continued through the phase of babbling. Once an infant had developed several babbling patterns, the caretaker played a game of follow the leader. After getting a vocal game going with one pattern, the caretaker was to shift to another, and then to another. As their infants developed skill in changing their vocalization to match that of the caretaker, the caretaker introduced phonemic combinations of Farsi, the language of Persia, that they had never heard their infants utter. Second, to foster semantic mastery, the caretakers were instructed to talk continually with their infant charges about the caretaking operations. Moreover, to sharpen the association of the infants' perceptions of events and things with the phonemic combinations heard in their caretakers' talk, the caretakers were instructed to time their utterances with their actions. My paradigm concerned ear-washing. The caretaker was to say, "Now I'm going to wash your ear," and as her vocal emphasis hit the word *ear*, her washcloth was to make contact with her infant's anatomical ear.

In this program of longitudinal research, the interventions constitute the independent or casual variable, and the mean ages at which the infants in the various waves achieved the various steps on our Piaget-inspired ordinal scales constitute the dependent, or consequent variables.

Results, General

No attempt will be made here to present the results of the successive interventions with each of the separate waves of infants. These are available in the monograph on the program (Hunt, Mohandessi, Ghodssi & Akiyama, 1976). You should know, however, that the abortive effort at audio-visual enrichment for Wave II seems to have caused some damage. The caretakers were instructed to give these infants the same care that they gave others in

their charge. Unfortunately, they apparently considered these infants to be getting extra care, so they may have relaxed their own efforts in their behalf. Otherwise, you should know that each of the successive interventions decreased the mean ages at which children achieved the upper steps on these scales. For the first 9 months, those of Wave IV, who got audio-visual enrichment, were ahead of these who got the untutored human enrichment and almost even with those who got the tutored human enrichment. During the second year, however, the 11 infants of Wave V, who got the tutored human enrichment, achieved the top steps on the scales far ahead of all of the preceding groups. Not only did these infants of Wave V achieve the top steps on all these scales at mean ages much younger than did those of the preceding waves, they also achieved the top-steps on five of the seven scales at mean ages younger than did the home-reared children of predominantly professional families in Worcester, Massachusetts (see Hunt, *et al.*, 1976).

Wave III – Posture and Locomotion

Like the serendipitous evidence of specificity that I have already described, the first one encountered in the Tehran study was completely unexpected. Upon arriving in Tehran in February of 1972 for my annual visit for inspection and planning, I got a big surprise. To understand my surprise, you need to know that when Wayne Dennis visited this orphanage in the winter of 1957, of those children in their second year, 60% were not yet sitting up, and of those in their fourth year, 80% were not yet walking. Such tremendous retardation of posture and locomotion had long since ceased to exist. Nevertheless, I had very seldom seen an infant sitting alone before he was about a year old, and I had seen only one infant standing on his legs and cruising around the crib before he was approximately 20 months old. Now you can understand my surprise when I discovered that all but one of the 10 infants in Wave III, who at that time were between 11 and 13 months of age and were receiving the untutored human enrichment, were not only sitting up alone but were also standing and cruising around their cribs while holding onto the sides. On the basis of my expectations from the casual observations mentioned, this looked like a very substantial advance in the onset of standing of the order of 6 to 8 months. Later, when we used a set of regularly made observations to check this impression, the average advance in standing and cruising was 29 weeks or 7 months. As soon as possible, I examined the examiner's records of performance on the Piaget-inspired scales. Not one of them showed at that time any appreciable evidence of advance in the ages of achieving the landmarks of the first year by the controls of Wave I. In fact, on several of these scales these infants receiving human enrichment were lagging somewhat behind the controls of Wave I.

In order to understanding this disappointing state of affairs, I asked the examiners what the three caretakers were doing for their 10 infants that caretakers would not ordinarily do when there was only one for 10 infants. According to their answers, the caretakers had done much more carrying the infants about in their arms. This provided them with an opportunity to use their sensorimotor balancing systems. Moreover, the caretakers had obtained some strollers, and they would put the infants in these strollers and pull and push them about. In these strollers, the infants could stretch out their legs, put weight on them, and even exercise the walking system. It was as if these caretakers considered the chief task of infants to be learning to walk. When I asked the examiners if the caretakers talked to their infants, they were puzzled by the question. I drew the impression that they were thinking: "Of course not, why in the world should they?" They, like the caretakers,

seemed to presume that since infants cannot talk, one cannot be expected to talk to them. When I tried to elicit vocal pseudo-imitation from these infants, I failed completely. Thus, at approximately a year of age, none of these infants were manifesting a landmark that I had considered typical of home-reared infants in their third month. The mean age at which the Worcester infants achieved this landmark was 8 weeks. Neither did they manifest the next lower step in the scale of Vocal Imitation, namely, that of showing facial expressions of pleasure in response to my best imitation of infant cooing sounds. During nearly daily visits for some three weeks, I made an attempt to elicit these expressions of facial pleasure and pseudo-imitation of cooing sounds from the two infants most responsive to me. Throughout these efforts, the facial expressions of both the caretakers and examiners showed what I interpreted as embarrassment for me. The idea of a grown man making baby talk to an infant was not fitting and proper. When one of the infants finally vocalized in my presence, and I immediately imitated her vocalization in response, we got a vocal game going. Soon the other child, then in my arms, got into the act. The examiners, who were college graduates who had majored in psychology at the University of Tehran, were both incredulous and amused. They told me they had no idea that vocal games could be played with such young infants. The relatively uneducated caretakers were completely incredulous and amazed. It was as if they had just observed something inconceivable. Nevertheless, over the week-end following this visit, the caretakers managed to elicit vocal pseudo-imitation from two more of the 10 infants in Wave III. I can only wonder if those infants in Wave III would ever have surpassed the controls in achieving top-level vocal imitation if I had not introduced vocal pseudo-imitation at this time. Clearly, opportunities to use balancing and stepping systems foster the development of posture and locomotion, but do not foster vocal imitation.

Language and Experience

Although I anticipated considerable specificity in kinds of experience and kinds of development from being familiar with scatter on the Stanford-Binet, none of those I have cited thus far were anticipated. There was a serendipitous aspect for each one. Contrariwise, the advances in vocal imitation and in semantic mastery were definitely anticipated from the consequences of the tutelage of the caretakers for the infants in Wave V. This tutelage, you will remember, included both the caretaker imitating the infants cooing sounds and then the babbling sounds, the follow-the-leader games, and the genuine imitation of new phonemes to encourage vocal imitation. It also included the procedures for sharpening the association of the infants' perception of events and things with the phonemic patterns used to symbolize them by the caretakers. In order to show the effects of these procedures, let me first give you the picture of vocal imitation and language behavior for Waves I and II so that you can have a standard against which to contrast the skills in vocal imitation and semantic mastery of the infants in Wave V.

Of the 25 infants in Waves I and II, only 15 ever achieved the top step on the scale of Object Permanence before they were moved to another orphanage. Using the median age of transfer (169 weeks) as a minimal estimate of the age of achievement for the 10 who failed, we obtain a conservative estimate of the mean age for achieving the top step on the scale of Object Permanence by all infants of Waves I and II as 127.2 weeks. Of the 11 infants in Wave V, all manifested the top step on this scale of Object

Permanence, and their mean age was 93 weeks. Thus, the difference between the two mean ages was 34.2 weeks or nearly 8 months. Moreover, only two of the 25 infants ever attained the top step on the scale for the development of schemes for relating to objects before transfer whereas all 11 of the infants in Wave V attained this step, and they attained it by a mean age of 90 weeks. Thus, the difference between the mean ages has to be greater than 79 weeks, or slightly over a year and a half. It is of interest in this connection to recall again that the infants of Wave V attained the top step of vocal imitation 5 weeks younger on the average than did the home-reared children of predominantly professional families in Worcester, Massachusetts, but they achieved the spontaneous naming an average of 4 weeks later than did the Worcester children.

It is important for you to know the general behavior and attractiveness of these children of Waves I and II. Apathy is probably the key word for their level of activity and motivation. I can recall only one instance that I would characterize as enthusiastic behavior on the part of one of these 25 children. That was when one of the boys in Wave I who had been a pet of the caretakers first stood and began to cruise around his crib. He was then between 15 and 16 months of age. From about a year of age on till they were transferred, the expressions worn by these 25 infants were universally apathetic and glum. They were not attractive little people.

It is of the essence to describe the language behavior of Waves I and II. At about 3 years of age, all but two of these children were still essentially without either expressive or receptive language. These two had both been pets of a caretaker. The evidence for an absence of expressive language was clear. They asked for nothing in spoken language. It is essentially accurate to say that they asked for nothing in any fashion. My evidence for an absence of receptive language is based upon what I like to call "horseback research," based on clinical tests devised on the spur of the moment. When these children were gathered into a kind of play or classroom, I would stand at one side of the room and ask either a caretaker or one of the examiners, with whom all of the children were highly familiar, to request a child "go to the man (me)." I would stand still, look directly at the child while usually smiling, but make no gesture inviting the child to approach. Only three of these children ever responded to such a verbal request. Yet, when I looked, smiled, and put out my hands invitingly, more than half of them quickly responded. Several were afraid of me and they would respond with crying and withdrawing farther from my gaze and gesture. Since they did not show crying and withdrawal to the request that they approach me, I gleaned that they simply did not understand the vocalized request. In another such test, one reminiscent of the three-year-level on the 1916-version of the Stanford-Binet test, I would place a sheet of paper on the floor beside a children's table, and then ask a caretaker or an examiner to request in Farsi that the child "pick up the paper and put it on the table." Only 2 of the 25 complied with this request. Yet, by gesturing them to come to me and pointing to the paper on the floor, then pointing to the table, and gesturing a movement from floor to table, I was able to get about half of the group to comply with this instruction once it was gestured.

Now let me contrast the characteristics of the imitative behavior, the social behavior, and the language behavior of the infants in Wave V with those in Waves I and II.

When I arrived at the orphanage for the first time during my last visit to Tehran in late October of 1974, I was keen to see these infants in Wave V

about whom my collaborators had been writing me. The tea ceremony took an inordinate amount of time it seemed, even for Persia. Finally the chief examiner came down the hall with a chessy-cat-like grin on her face. After a quick cup of tea, she took me to the playroom to see the children. As we came to the door, the caretakers formed a semi-circle with their three or two toddlers in front of them. As I entered the door, they called out in unison, "Hello!" At this point I was told why the tea ceremony had been so prolonged. They had hoped to get these children to say in unison, "Hello, Dr. Hunt." This goal proved too demanding, so they settled for "hello."

Consider next skill in vocal imitation: Soon after I entered the playroom, Cambiz, a boy of nearly 24 months and the oldest of the group, came forward smiling and with his arms gesturing to be picked up. I carried him about as several caretakers were being reintroduced. When he objected to being put down as we left the playroom for the examining room, I carried him along. As we entered the examining room, he saw through the window on the opposite side a water sprayer, and immediate he began repeated and excited shouting of: "Ab, ab, ab. . ." *Ab* is the word for *water* in Farsi. This was "spontaneous naming" with a vengeance. Impulsively, I decided to try to teach him the English word, *water.* I called his name, "Cambiz," and said "water." Cambiz responded "ab, ab, ab. . ." After several such attempts, I decided that the sprayer would have to be out of sight before I could possibly get Cambiz to play the "imitation game." We went into the hall where the sprayer was out of sight. There I tried again. I would say, "Cambiz, *water.*" This time Cambiz immediately responded with an approximation, "awter," missing the sound symbolized by the letter *w* at the beginning of the word. In eight or 10 presentations of the model "water," some with extra emphasis on the sound sympolized by *w*, Cambiz said the English word, *water,* as clearly as I said it. As we reentered the examining room, however, Cambiz reverted to "Ab, ab, ab . . ." Clearly I had not taught him a new word for the stuff that comes out of the sprayer. I had merely got him into the "imitation game." Nevertheless, his skill in imitation was clearly demonstrated. It was demonstrated again in similar fashion when I had put my glasses away, out of sight to keep him from repeating "enack," the word for glasses in Farsi. Once I got the glasses out of sight, again I could readily get Cambiz into the imitation game and he learned to say the English word, "*glasses*" in the course of a dozen or so repetitions. When I was told that the phoneme *gl* at the beginning of a word does not exist in Farsi, the imitative skill of this little two-year-old boy became doubly impressive.

Evidence came quickly that his imitative skill had resulted in genuine language. Later that first morning, Shabnam, then in her 18th month of age and the youngest of the group gestured to be picked up. As I held her, the chief examiner undertook to demonstrate that Shabnam could imitate the names of all of the children in Wave V. Shabnam's imitative rendition of the sounds modeled by the examiner sounded good to me. Finally, the examiner came to the name, "Yass." Now Yass I had never seen because she was adopted the week before I arrived. As the examiner modeled the name, "Yass," Shabnam's manner and expression changed. She shifted in my arms simultaneously throwing her left arm toward the door, and said "Yass rangeh." I was puzzled, and the examiner translated in English for me, "She says, 'Yass is gone,'" This was highly impressive for this was clearly a sentence reflecting her understanding of an actual state of affairs. She had not only the knowledge of Yass' absence but she had also semantic mastery of that knowledge. She could symbolize it in Farsi words and also supply the syntax for an understandable utterance.

At this point, I suggested a new approach. The chief examiner was to touch various features and parts of Shabnam's body and clothes, while asking "What is it?" The examiner's English is limited, so she did not immediately understand, so I asked "How does one say in Farsi, 'what is this?'" She then taught me to say what I can best with English letters render as "In chi aay?" Once I could say "What is it?" in Farsi, I pulled Shabnam's hair while saying, "In chi aay?" Shabnam immediately responded with "muh," the Farsi word for *hair*. From this iittle girl in her eighteenth month, came the Farsi words for nose, eyes, mouth, ears, neck, chest, knee, hand, foot, and the names of the garments she wore. What I learned about Shabnam's vocabulary held for all of the infants that I attempted to examine.

Some of those children who were between 20 and 24 months of age had even acquired semantic mastery of the elementary abstraction of color. I learned this after I had observed the caretaker of Monee handing him the rings of the stacking toy as she named their colors. Monee uttered the names of the colors in what appeared to me to be perfect imitation of the caretaker's vocal models. This made me curious about whether he really knew the names of the colors. First, I found out how to ask in Farsi, "What color is that?" Then I learned the sounds for the red, yellow, green, blue, and orange. Then I picked up each ring and asked Monee, "What color is that?" Monee responded with renditions of the Farsi words for red, yellow, green, blue and orange just as clearly as he had uttered them in the imitative situation.

At this point I wondered whether these color terms were semantically limited to these particular rings or if he had semantic mastery of colors in the abstract. After taking him in my arms and leaving the playroom, we walked along the wall of this new orphanage where there were colorful pictures. I pointed to a part that was clearly *red*, and asked, "What color is that?" Monee responded immediately with the Farsi word for *red*. He was able to name correctly splotches of color in several of these pictures for all four of the primary colors and orange. Two of the other children, also among the older ones in the group, had some degree of semantic mastery for the elementary abstraction of color. They named the colors pointed in the pictures, but they were not consistently correct. When one considers that less than a quarter of the children of Head Start can name colors consistently, this is no mean achievement for children of two.

Following this visit, one of our graduate students in psycholinguistics made up a test of linguistic competence based on my suggestions, and the chief examiner administered it to the children in Wave V, to those children remaining in the orphanage from Wave III who got the untutored human enrichment, and to children in the orphanage from Wave IV who got the audio-visual enrichment. This test consisted of eight parts: (1) answering the question, "What is your name?"; (2) imitating a sample of 10 unfamiliar words of one or two syllables; (3) touching such parts of the body named as nose, eyes, ears, hand, foot, mouth; (4) naming four primary colors (red, yellow, green and blue) as indicated in response to the question: "What color is that?"; (5) responding to a request demanding discriminations of size: "Give me – 'the big one,' 'the long one,' 'the little one,' and 'the short one'"; (6) placement and prepositional relationships involving a block and a box partially covered. The child's task was to respond to a request: "Put the block – in, on, under, in front of, and behind – the box;" (7) following instructions such as: "Give your doll water," "Wash your doll's face," "Comb your doll's hair," etc.; (8) repeating complex sentences.

When the imitative performances of the infants of Wave V were compared with those of children matched by age and sex who had been reared under the standard rearing practices of the orphanage, the superior quality of those in Wave V was such that the score of the poorest performance by a child in Wave V was substantially superior to that of the best of those reared under standard conditions. Moreover, when the performances of the children in Wave V, then between 21 and 27 months old, were compared with those of the four children available from Wave III who were somehwat more than two years older at the time the accuracy of pronunciation of the ten unfamiliar words by those in Wave V was judged to be definitely superior to the accuracy of pronunciation by the children in Wave III. The accuracy of pronunciation by Wave V was also superior to that of those children still available from Wave IV.

In sum, then, the interventions in the rearing practices for Wave V were highly successful in advancing the achievement of top-level vocal imitation, highly successful in producing accuracy of vocal imitative skill, highly successful in producing semantic mastery of those objects and events with which these children were familiar. Moreover, even though no effort was made to inculcate syntax, these children not only named objects spontaneously, they used language as a means of communicating with each other, made requests in language, and even reflected their knowledge of such states of affairs as the absence of Yass from the group in syntactical fashion.

The social and motivational behavior of these children in Wave V was also a startling contrast to that of the children in Waves I and II. The children of Wave V generally approached situations with enthusiasm. They made requests and even demands and repeated them, often persistently. They approached those they knew and even such strange people as I, a visiting psychologist from America, with confidence. They acted generally with trust, or as if they expected to be well liked and well treated. I judged them to be very attractive two-year olds. This judgment of mine got a certain confirmation from the fact that seven of these 11 two-year-olds in Wave V were adopted by families which the chief examiner characterized as "very high people." When one considers that of the 57 children who participated in Waves I, II, III, and IV, only two were ever adopted and those were adopted before they were 6 months old because they were pretty babies, this adoption of 7 of 11 in Wave V because they were attractive two-year-olds is impressive evidence that the tutored enrichment influenced not only cognition and language, but the social and motivational attractiveness of these children.

This contrast of the behavioral characteristics of the children in Waves V at about age two with the characteristics of those of Waves I and II at between age two to three or three-and-a-half is to me highly convincing that the experiences provided by the rearing conditions for the first two or three years are extremely important in determining such characteristics. The contrast demonstrates quite dramatically the effects that education in infancy and early childhood could have if we knew the kinds of experience that foster each branch of psychological development.

How these children in this program will fare in the future is still undetermined. It will depend very largely on their future experiences. Those of Wave V who were attractive enough and fortunate enough to be adopted will probably develop the competence and motivation and social habits which will carry them to the upper strata of the mainstream of Iranian

society. Those of Wave V who were not adopted can hardly be expected to fare so well, but I would guest that they will fare better than those of Waves I and II who would require intensive therapy that they are very unlikely to get in order to develop the competencies, the motivation, and social habits required for participation even in the lower portions of the mainstream of Iranian society. When Harold Skeels (1966) made his follow-up visits to the 13 children transferred from the orphanage to the institution for the mentally deficient, where they were doted on by moron women, and were later placed in adoptive homes and also those 12 children, with initially higher development quotients who remained in the orphanage environment (Skeels & Dye, 1939), the contrast between the two groups as adults was remarkable. All thirteen of those who were transferred from the orphanage to the institution for the mentally deficient and later placed for adoption were, at the time of follow-up, self-supporting. Of the 12 with originally higher developmental quotients who remained in the orphanage, one died in adolescence following continued residence in a state institution for the mentally deficient, five others are still wards of state institutions; three are among the unemployed, and the remaining three were marginally employed as "hewers of wood and drawers of water." In education, for the group transferred and adopted, the median grade completed was high school graduation, while the median for the contrast group was less than the third grade. Of the former group, four had one or more years of college, and one graduated and later earned a doctorate. Of the former group, 11 have married, and 9 of those have had children. Of the contrast group, only two had married, and one of those had been divorced. Should it be possible in 1995 to conduct such a follow-study of these children in Wave V and those in Waves I and II, I would expect to find a similar contrast.

EDUCATIONAL IMPLICATIONS AND CONCLUSION

First of all, new evidence and theoretical considerations unavailable in the early 1960's show that the belief in psychological development predetermined by heredity is even further from the truth than the earlier evidence would indicate. This statement does not mean that findings derived from the investigative model suggested by the genetic concept of the norm or range of reaction is far more relevant to educability than are the indirect estimates derived from subtracting percentage estimates of heritability from one hundred. Moreover, the few findings we now have from the investigative strategy suggested by the range of reaction indicate that differing biographies of adaptive experience, especially in the earliest years, can make far more difference than I thought possible in 1959 and 1960 when I wrote *Intelligence and Experience* (Hunt, 1961).

Second, I have reported evidence that the hypothesis of global development or the idea that development proceeds at the same rate along all systems simultaneously is simply not true. Despite my familiarity with the evidence of scatter on the Stanford-Binet, an element of serendipity has entered into all instances where evidence of such specificity has occurred except one, namely, the effects of the procedures taught to the caretakers of Wave V in order to foster the development of vocal imitation and semantic mastery. The visit to the laboratory of Burton White revealed quite unexpectedly the specific but tremendous advancement of eye-hand coordination brought about by his experimental enrichment with institutionally reared infants as compared with our home-reared infants. That visit also

revealed the tremendous retardation of vocal imitation in his institutionally-reared infants as compared with those home-reared who were subjects in our study. Again, we certainly did not expect the infant and toddler learning programs of Earladeen Badger to advance the achievement of object construction in the children of Mt. Carmel by six months ahead of that achievement in the home-reared children from predominantly professional families of Worcester while leaving vocal imitation in the Mt. Carmel children five months behind that in the Worcester children. We certainly did not expect the differing conditions of rearing at the Municipal Orphanage, the Metera Center, and the working class homes of Athens to have such differing effects on the rates of development of object permanence, vocal imitation, and gestural imitation. The specific effect of reducing the infant-caretaker ratio from 10/1 to 10/3 in Wave 3 at the orphanage in Tehran on posture and locomotion along with failures to advance development along the Piaget-inspired scales was also a surprise.

While such surprises provide convincing evidence of the existence of specificity between kinds of experience and kind of development, they are of educational significance only as they suggest verifiable hypotheses about the kinds of experience which foster development along each branch. The study at the Parent and Child Center at Mt. Carmel has suggested a hypothesis which, thus far, we have been unable to test. Early in that study, we were highly surprised by the evidences of early achievement of landmarks on the scale of Object Permanence. At one point, we considered the possibility that our test might be trivial in the sense of indicating only that the children were learning to pull covers off desired objects. When we found that they would not only retrieve desired objects that disappeared in such a container as a chalk box which, in turn, disappeared in a series of wastebaskets and then came back empty, we had more faith in our test. When we sought the experiences that might account for this hastening of object construction, we learned from the mothers who served as caretakers that a shape box was the toy in which the children were most consistently interested. This shape box demanded that an infant thrust a block of a given shape through a hole in the top. Once through that hole, the object disappeared, but the child could lift the lid and retrieve it, and then repeat the action. These shape boxes occupied these 8 infants for perhaps half an hour regularly while they were in the Center for day-care. I had hoped to test the effect of these boxes on object permanence in Waves IV and V in Iran. A dozen of them were shipped to the orphanage of the Queen Farah Pahlavi Charity Society along with written instructions for their use. Written instructions, however, do not always communicate even to people trained in the U. S. Two years separated my visits in 1972 and 1974. Upon arrival for my final visit in 1974, I found those shape boxes neatly stacked in a storeroom. For caretakers, they seemed clumsy, and they took up space in the nursery playroom. Yet, the suggestive discovery at Mt. Carmel does not provide a useful hypothesis concerning the nature of an experience with which to foster object construction.

Any dependable educational psychology for infancy and early childhood demands far more knowledge of these specificities of relationship between kinds of experience and kinds of development than we now have. Traditional learning theory fails to recognize the hierarchial nature of psychological development in which one achievement builds upon another gradually through the adaptive accommodations that an infant makes to new situations encountered if they are appropriately matched to earlier achieve-

ments. Traditional learning theory does not recognize the epigenetic nature of developmental process and what I like to call "the problem of the match." If an environmental encounter is to foster development, it must both engage the infant or child and be discrepant enough from those he has encountered before to call forth an adaptive modification in his ready-made sensorimotor organizations yet not so discrepant as to require adaptive modifications beyond his capacity. We embarked upon Project Head Start with a tremendous ignorance of these relationships and of the specificities between kinds of experience and kinds of development. Not until we understand them can we expect to have a dependable educational psychology for infancy and early development.

The success of our tutelage of the caretakers with the children in Wave V illustrates the value of understanding the kinds of experience that foster development along given branches such as vocal imitation and that foster coordination between branches such as that between vocal imitation and object construction. The evidence I have summarized suggests that every child born without pathology has the genotypic potential necessary to acquire the knowledge and skills required for productive participation in any culture of the world. The finding that relatively uneducated people from the poverty sector consider adult imitation of the sounds of infants to be silly coupled with the finding that they were inclined to talk much less with their infants and young children than other relatively more educated people of middle-class suggest that the procedures utilized in the tutelage of our caretakers for Wave V might, if taught to mothers, along with the infant and toddler learning programs of Earladeen Badger, serve substantially to reduce the cognitive and linguistic deficiencies of children from the under-classes.

Thank you

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